EFFECTIVENESS OF AN ERROR KEY FOR IMAGE INTERPRETATION IN VIETNAM

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Army Behavior and Systems Research Laboratory
Arlington, Virginia

September 1972

Technical Research Note 230

AD

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U. S. Army

Behavior and Systems Research Laboratory

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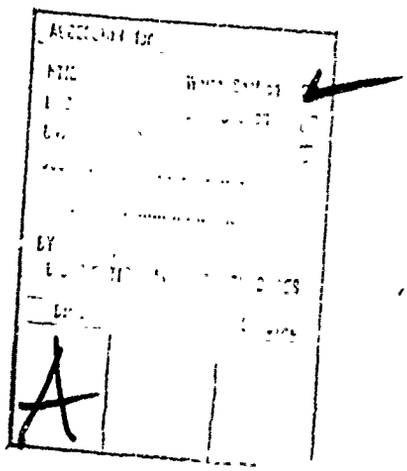

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Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Behavior and Systems Research Laboratory, Arlington, Va. and North American Rockwell Information Systems Company, Anaheim, California	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

EFFECTIVENESS OF AN ERROR KEY FOR IMAGE INTERPRETATION IN VIETNAM

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

Harold Martinek and Richard E. Hilligoss (BESRL), and Bruce Herrington (NARISCO)

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September 1972	39	2

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. 20662704A721	Technical Research Note 230
c. Advanced Surveillance Systems	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. b-	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Asst Chief of Staff for Intelligence, DA, Wash. D. C.; Office of Chief of Research and Development, DA, Wash., D. C.

13. ABSTRACT

-- Experimentation to develop a specialized reference key to enable interpreters to avoid certain common errors in reporting information derived from imagery taken over Vietnam is reported in the present Technical Research Note. The research study, a joint effort of personnel of the Behavior and Systems Research Laboratory (BESRL) and of the North American Rockwell Information Systems Company (NARISCO), was undertaken to construct and validate a new type of reference -- an error key -- for use in Vietnam. The key was constructed from operational imagery of Vietnam territory with annotations pointing out types of error to be avoided. Evaluation was conducted using trained interpreters to determine if use of the error key would achieve the following effects on image interpreter reports: 1) increase number of right responses; 2) decrease number of wrong responses; and 3) increase accuracy of identification.

Performance results achieved by 122 enlisted image interpreters (recent II Course graduates) were used in evaluating effectiveness of the error key. Each of two matched groups interpreted two sets of imagery, one set using the error key, the other without using the key. Analysis of results showed that 1) the BESRL error key significantly improved the accuracy of inexperienced interpreters in dealing with operational imagery on Vietnam--39% increase in rights, 26% decrease in errors made, and 43% increase in accuracy rate; 2) the error key significantly improved the completeness of reporting on the subject imagery; and 3) differences in performance as a function of mission and group were evident.

I

DD FORM 1 NOV 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
*Image interpretation						
Surveillance systems						
Image character						
*Reference key						
*Error key						
*Interpreter performance						
*Operational imagery						
*Identification						
*Accuracy rate						
Image Interpretation (II) Course						
*Field utilization - Vietnam						
Conventional key						
Interpretation reports						
Laboratory facilities						
Military Psychology						
Tactical targets						

II

DD Form 1473

13. ABSTRACT - Continued

For optimal operational use, the present key should be extended to include different areas of Vietnam, different scales and types of photography, and different sensors such as infrared. There is apparent advantage to be obtained in use of the key in the field (Vietnam) and for training in the Image Interpretation (II) Course.

III

Technical Research Note 230

AD

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September 1972

IV

Army Project Number
20662704A721

Advanced Surveillance Systems-b

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FOREWORD

The ADVANCED SURVEILLANCE SYSTEMS research program of the Behavior and Systems Research Laboratory has as its objective the production of scientific data bearing on the extraction of information from surveillance displays, and the efficient storage, retrieval, and transmission of this information within an advanced computerized image interpretation facility. Research results are used in future systems design and in the development of enhanced techniques for all phases of the interpretation process. Research is conducted under Army RDT&E Project 2Q662704A721, "Advanced Surveillance Systems," FY 1972 Work Program. BESRL research in this area is conducted as an in-house effort augumented by contracts with organizations selected as having unique capabilities and facilities for research in aerial surveillance. The present study was conducted jointly by personnel of the Behavior and Systems Research Laboratory and North American Rockwell Information Systems Company (NARISCO).

The BESRL Work Sub-unit, "Influence of Displays on Image Interpreter Performance", focuses on research to determine how interpreter performance is affected by variations in the character of the image. The present publication reports on experimentation to develop a specialized reference key to enable interpreters to avoid certain common errors in reporting information derived from imagery taken over Vietnam.

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Behavior and Systems
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EFFECTIVENESS OF AN ERROR KEY FOR IMAGE INTERPRETATION IN VIETNAM

BRIEF

Requirement:

To construct and validate a new type of reference--an error key--to help image interpreters produce more accurate and complete interpretations of operational imagery of Vietnam.

Procedure:

Categories of error to be treated in an error key were determined from the interpreter performance of recent enlisted graduates of the Army Image Interpretation Course at Fort Holabird. A key was constructed using operational imagery of Vietnam similar to but not identical with that used later to evaluate the key. Effectiveness of the key was evaluated using results achieved by 122 enlisted graduates of the above course. Each of two matched groups interpreted two sets of imagery, one set using the error key, the other without using the key. Results were analyzed for number of correct identifications, number of wrong identifications, and accuracy of identification.

Findings:

Practical and significant improvement with use of the error key was found--a 39% increase in the number of right responses, a 26% decrease in the number of errors made, and a 43% increase in accuracy rate.

Utilization of Findings:

Use of the BESRL Error Key can improve significantly the accuracy and completeness of the product of school trained but inexperienced U. S. Army interpreters viewing operational imagery of Vietnam. The key can be used to advantage in the field in Vietnam and for training in the Image Interpretation Course.

The technique of error avoidance demonstrated by the key can be extended both in the field and in the school to other imagery for different regions of the world.

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EFFECTIVENESS OF AN ERROR KEY FOR IMAGE INTERPRETATION IN VIETNAM

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TABLES

EFFECTIVENESS OF AN ERROR KEY FOR IMAGE INTERPRETATION IN VIETNAM

BACKGROUND

Image interpreters traditionally utilize a wide variety of informal and formal references (keys) in performing their interpretation tasks. Informal references may be notes, sketches, or annotated photographs. Formal references are pictorial depictions of various targets under various conditions. These photointerpretation[1] (PI) keys came into existence early in World War II as a result of British-sponsored efforts in aerial reconnaissance. In the United States, production of keys began as a matter of expediency under a great deal of time pressure. The earliest keys, which illustrated industrial facilities of various types, did much to set the pattern for subsequent keys produced in the United States. As requirements for identification of new target categories evolved, military expediency still ruled out any broad review of photographic interpretation key techniques before a given key was prepared for use. Because of extremely diverse subject matter and urgent need, little standardization in format, terminology, or technology was achieved during this period.

The war in Korea directed attention to the need for updating and expanding keys to cover new targets and target areas. Again, time pressure and expediency dictated many of the ground rules. The period from 1950 to 1958 was one of intensified key production, with interest concentrated on production, expeditious update schedules, preplanning of keys and ways of presenting keys. Attention was also given to the formal layout and approach to be used in preparing keys. Considerable standardization was achieved at this time through a joint service production program. Most keys were quite elaborate, giving different views and precise descriptions of the targets in question and their associated features, although some keys were quite simple, showing only outline sketches of targets to be identified and giving their length and width.

The main purpose of a key is to help the interpreter make a more accurate and complete identification of objects shown on the imagery. It thus serves as a standard for comparison of a suspect target with a known target. Keys are particularly useful when image quality is marginal, when the target to be identified is atypical of its class, or when the target is one seldom encountered in normal work. Of course, like any other reference material, keys also can be used for training purposes.

Since one function of keys is to reduce error in interpreter reports, it was felt that error might be still further reduced by use of an error key which, unlike the conventional key, depicts commonly occurring errors.

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[1] Later termed image interpretation (II) keys to include newer forms of imagery such as infrared and radar.

The error key explains what the objects which resemble the target really are and how they differ from the target. The conventional key makes no mention of the possibility that other objects may look like certain targets but only discusses attributes of actual targets. The difference between the two keys is illustrated by the following statements about weapons positions:

> Conventional Key. Two open positions joined by connecting trenches with clear fields of fire. . .
>
> Error Key. The items at (1) are not weapons positions but are graves with walls surrounding the grave mound with a path from village to grave site. Poor tactical position (such as no field of fire) is clearly indicated.

An earlier study[2], based on World War II imagery, demonstrated the value of an error key. Use of an error key resulted in an operationally useful and statistically significant decrease in errors in interpretation reports concerning convoys and artillery positions. Since the key used was designed to reduce false alarms (reporting a non-military object as one of military significance), its use did not affect the number of right identifications made.

An error key approach seemed particularly appropriate to the Southeast Asia situation because of the likelihood of confusion because of the similarity of military and civilian enemy activities. Moreover, after an analysis of image interpretation reports of inexperienced image interpreters in Vietnam, it became apparent that, in addition to a need for reduction of false alarms, common errors of omission (not reporting a military target) were also a subject for error reduction.

PURPOSE

The objectives of this effort were to construct and evaluate an error key for use in Vietnam. The key was to be constructed from operational imagery of Vietnam territory with annotations pointing out types of error to be avoided. The evaluation was conducted using trained interpreters to determine if use of the error key would achieve the following effects on interpreter reports: 1) increase rights, 2) decrease wrongs, and 3) increase accuracy.

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[2] Martinek, Harold, and Robert Sadacca. Error keys as reference aids in image interpretation. Technical Research Note 153. Behavior and Systems Research Laboratory, Arlington, VA. June 1965.

CONSTRUCTION OF ERROR KEY

In the first phase of construction of the error key, imagery taken over Vietnam territory was interpreted by 50 recent graduates of the enlisted Image Interpretation Course at Fort Holabird, and their interpretations were analyzed in order to define errors. In the second phase, imagery selected as representative, based on the analysis of typical errors, was assembled into a key and instructions for key use were prepared.

Error Definition

To identify errors typically made by image interpreters, imagery was selected from two missions. MSN 5536 covers an area of Vietnam located approximately 40 miles northwest of Saigon. The terrain is mostly flat with meandering streams. Nearly two-thirds of the area is either wooded or abandoned agricultural land. The remainder is actively cultivated in tea and row crops. There are two urban centers. The other mission, MSN 6358, covers an area located 15 to 20 miles southwest of Saigon. This area is intensively cultivated, with rice as the principal crop. Some trees are found in the hamlets and bordering streams. The Yam Go River flows through a corner of this area. The approximate scale of both missions is 1:5000. The missions consist of prints in 9" x 18" format. Thirteen prints were used from MSN 5536 and 19 from MSN 6358. Interpretation reports were collected following the procedure described in Appendix A, Instructions to the Examinee. The examinees used the same target list (Appendix C) and report form (Appendix D) as were later used in the evaluation experiment. Each interpreter had available stereoscopes (2X and 4X), and 8X tube magnifier, and a slide rule. Objects found by the interpreters were annotated by number in grease pencil directly on the paper prints. This procedure avoided the possibility of errors in reading and transcribing coordinates. The description of the object found was recorded on a special target reporting form. Each response was recorded on a master set of imagery to allow analysis to determine what image characteristics tended to attract interpreters' attention most often. Tabulation of responses was then analyzed for errors of two types, false alarms and omissions. Errors were classified, first by false response and then by the non-military object or terrain feature believed to have caused the error.

Table 1 shows the false alarm targets classified into eight categories--weapons positions, vehicles, sampans, etc. Objects giving rise to false alarms included graves, craters, brush, and trees. The two image sets produced similar but not identical errors. For example, 10% of the false alarms from MSN 6358 were reports of mine fields but no mine fields were reported on MSN 5536. For MSN 5536, total false alarms were 219 with 87% classifiable; for MSN 6358, there were 336 false alarms with 96% classifiable.

Table 2 presents the omission errors by mission and target type. The first column under each mission presents the number of targets present in that mission for each of twelve target types. Comparison of these

Table 1

TARGET TYPES INVOLVED IN FALSE ALARMS

False Alarm Target Type	Missions 5536	Mission 6358
Weapons position	42%	29%
Vehicles	16	6
Sampans	13	29
Supply points	10	19
Personnel	10	2
Tunnel entrances	4	1
Mine fields	0	10
Bunkers	6	5
	101%	102%
Object Giving Rise to False Alarms		
Graves	34%	29%
Craters	22	3
Brush and trees (ground)	20	16
Brush and flotsam (rivers)	0	25
Straw	12	26
Wells	12	1
	100%	100%

Table 2

OMISSION ERRORS BY MISSION AND TARGET TYPE

Targets Omitted	MSN 5536 Col. 1 Number present in MSN	MSN 5536 Col. 2 Percent omitted	MSN 5536 Col. 3 Percent of total omissions	MSN 6358 Col. 1 Number present in MSN	MSN 6358 Col. 2 Percent omitted	MSN 6358 Col. 3 Percent of total omissions
Weapons positions	16	85	13	6	93	1
Vehicles	7	82	5	65	100	11
Sampans	18	88	15	57	92	9
Supply points	5	93	4	*	--	--
Personnel	60	99	56	477	100	75
Tunnel entrances	*	--	--	*	--	--
Mine fields	*	--	--	*	--	--
Bunkers	*	--	--	*	--	--
Trenches	6	88	5	2	85	0
Strong points	3	69	2	3	90	0
Bridges	*	--	--	26	86	4
Road blocks	*	--	--	1	67	0
	115		100%	637		100%

* None present on imagery.

figures indicates a difference between missions in number and kind of targets present. Column 2 for each mission gives the percentage of errors of omission for each target type and is an index of the difficulty of finding each target type in this imagery. Column 3 gives the percentage of total omissions and is an index of how much impact this error of omission will have on the total report of the mission. For example, a high percentage in column 2 could have little effect if column 1 indicated that only one target was present. The percent omitted values (column 2) were obtained by summing separately for each target the number of omissions for all examinees, and then dividing this sum by the product of the frequency of occurrence of the target and the number of examinees. The percent of total omissions values (column 3) were obtained by again summing, separately for each target, the total number of omissions for all examinees, then dividing the sum by the total number of omissions for all targets by all examinees.

Based on these results, vehicles, sampans, and personnel were selected as the targets to be emphasized in the error key because of their high difficulty (column 2) and high impact on the interpreter's report (column 3). Weapons positions were initially included as a target type to be considered, but were rejected because of disparity in results between the two missions. Also, it was felt that added emphasis on this type of target might increase one of the severest problems in false alarms reporting (Weapons positions was the largest error category in Table 1.)

In addition to the above analyses, high pan imagery from MSN 8037, scale 1:8000, covering more rugged terrain with heavy forest cover, was analyzed in a similar procedure, although much less completely. Similar but not identical error types were found and included in the final error key, to provide a more general key. However, high pan imagery was not included in the evaluation of the key. The additional error types found were identified as slow-down obstacles, mud puddles, trails, and ditches.

Error Key Preparation

The error key consists of three pages, two pages with two stereo pairs on each and one page with four non-stereo images. The stereo pairs of the error key were also prepared from imagery taken from MSN 5536 and MSN 6358, but did not include imagery frames used in the study. The non-stereo chips were taken from MSN 8037.

From three to nine objects were annotated on each illustration. A brief description of each annotation was included. A more thorough discussion was presented in an attachment sheet which consisted of no more than a four-sentence description of an individual annotation. Descriptions were presented in two basic formats, a cautionary note type and a not type. These two types of statement were intermingled in the narrative as appropriate to provide variety. Below are examples.

Cautionary Note. Annotation (1) shows walled graves of a special type frequently misidentified as vehicles. The length-width ratio, square corners, and flat appearance inside the low walls can be very deceptive, particularly when a few graves of this type are found in isolation. Noting the lack of clearly associated trackage together with careful measurement will identify these objects as graves.

Not Statement. The items at (1) are not weapons positions but mound graves which are sometimes found in groups, with the older ones almost completely overgrown. General diagnostic features of the graves--random arrangement, absence of trackage, size, siting, etc.--should be noted in making identifications. Annotation (2) indicates not foxholes, but wells of a certain type dug into the dikes between fields. Wells are usually old and regularly spaced along the entire length of the dike. Foxholes and weapons positions are usually more numerous and freshly dug and not as regularly spaced.

The verbal portion of the key was read slowly to the examinees with appropriate pauses to give them sufficient time to study the examples shown on the imagery. The examinees then were allowed to keep the error key at their work stations to use during the testing. Appendix B contains the descriptive material of the Error Key.

EVALUATION OF ERROR KEY

The general procedures for the evaluation experimentation was to have a new sample of interpreters extract information from photographs with and without use of the error key. In addition to the test imagery (which was the same as that used for error definition) and the error key, examinees were given a Southeast Asia target list (Appendix C) and an interpretation report form (Appendix D). The target list established information requirements to which the interpreter was to respond. The first section presented a list of specific items to be annotated on the imagery such as sampans and weapons positions. The second was a Remarks section requiring reports of three types as appropriate, but no annotations. These reports dealt with the approximate number of foxholes, amount of trail activity, and number of road cuts to be found in an individual photo.

The answer sheet provided space for the target entry and associated remarks in separate columns. The associated remarks could provide such information as: "Sampan is motorized". "Personnel plowing or gathering crops." "Object is one-man foot bridge." Space was also provided for an estimate of confidence attached to each target located, using the levels Certain, Probable, Possible.

Sample Used in Evaluating Key

The image interpreters used in evaluating the error key were 122 enlisted men, recent graduates from the Image Interpretation Course at Fort Holabird, Maryland. During their training, they had received more than eight hours of intensive instruction on Southeast Asia targets. Training included use of a conventional key for interpreting imagery obtained in insurgency and counter-insurgency situations. Additional training on Southeast Asia targets was provided in various parts of the course concerned with other topics. For example, in training on the interpretation of infrared imagery, at least some of the examples presented were taken in Vietnam and showed typical Southeast Asia targets.

Experimental Design

A 2 x 2 x 2 Latin square design with replication was used, each examinee serving as his own control. This design allowed for a relatively sensitive test of the main variable (interpretation with key versus without key). The independent variables were two sets of imagery (Missions 5536 and 6358), two groups of matched examinees, and the two key conditions. Design is shown below:

	Day I Without Key	Day II With Key
Group A	MSN 5536	MSN 6358
Group B	MSN 6358	MSN 5536

A possible source of confounding occurred because the test with use of key was always administered after the no-key test. Thus, examinees under the key condition were exposed to more Vietnamese imagery, having previously been engaged in interpretation under the no-key condition. This effect was believed to be minimal because there was no feedback to the examinees on their work under the no-key condition and thus little if any learning. Moreover, different imagery was used for the two conditions.

Dependent Variables

Rights Score. Number of correct identifications. This score is perfectly correlated with completeness, the latter defined as the number of right responses divided by the number of targets present in the imagery. Consequently, completeness and number of correct identifications can be used interchangeably in statistical analysis. Completeness of a report is important in that it is a measure of how many targets are unreported (errors of omission), in other words, the "unknowns" a commander has to consider.

Wrongs Score. Number of incorrect identifications (errors of commission). This score gives an indication of the number of erroneous targets an interpreter reports. Wrong interpretations can be of two types:

1. Misidentifications where a militarily significant target (truck, tank, etc.) is identified as some other military target.

2. False alarms where a non-military object (brush, logs, a well, a shrine, etc.) is interpreted as a militarily significant target (tank, dugout, AA position, bunker, etc.). Either of these types may cause the commander using the intelligence information to have a wrong estimate of enemy capability and possibly make an incorrect commitment.

Accuracy Score. Number of rights divided by rights plus wrongs. This score informs the commander of the number of true targets relative to the total number reported, and consequently how much faith he can have in the report.

RESULTS

Effect of Error Key

Rights. The F values in Table 3 show that the mean difference in the rights scores between using the error key and not using the error key was significant at the .05 level. Table 4 shows that the total number of correct responses increased from a mean of 25.05 for the no-key group to a mean of 34.88 for the group using the key, an increase of 39%. Thus, use of the error key resulted is a statistically significant and operationally useful increase in the number of correct targets the interpreters found--in other words, a useful increase in the completeness of the report. The complete analysis of variance tables are given in Appendix E.

Wrongs. Table 3 also shows that the mean difference in the wrongs score between the key/no-key conditions was significant at the .05 level. From Table 4, the number of incorrect responses decreased from a mean of 45.6 in the no-key group to a mean of 33.8 for the key group, a decrease of 26%. Thus, not only does use of the error key increase correct responses but it also results in a statistically significant and operationally useful decrease in the number of wrong identifications an interpreter reports.

Accuracy. The mean difference in accuracy was significant at the .05 level (Table 3). Since use of the error key both increased the number of rights and decreased the number of wrongs, it was expected that accuracy would be substantially greater with the key than without. In fact, mean accuracy increased from 35 to 51 (43%) with use of the key. Use of the error key thus produces a statistically significant and operationally useful increase in the accuracy rate of interpretation.

Table 3

F VALUES OF ANALYSIS OF VARIANCE

	Rights F value	Wrongs F value	Accuracy F value
Keys	41.549*	17.906*	69.656*
Groups	8.10*	1.614	0.741
Missions	23.789*	17.906*	3.521

*Significant at .05 level.

Table 4

KEY VS NO-KEY COMPARISONS - MEAN RIGHTS, WRONGS, AND ACCURACY

	Mean Rights	Mean Wrongs	Mean Accuracy
No key	25.0	45.6	35.8
With key	34.9	33.8	50.8

Table 5

GROUP COMPARISONS - MEAN RIGHTS, WRONGS, AND ACCURACY

	Mean Rights	Mean Wrongs	Mean Accuracy
Group A	33.1	42.8	43.7
Group B	26.8	36.6	42.3

Table 6

MISSION COMPARISONS - MEAN RIGHTS, WRONGS, AND ACCURACY

	Rights	Wrongs	Accuracy
MSN 5536	26.2	33.8	43.7
MSN 6358	33.7	45.6	42.5

Group and Mission Effects. Analysis of the effectiveness of the Error Key in terms of rights, wrongs, and accuracy, was the primary objective of the experiment. However, control on groups and mission from which the imagery was taken was included in the analysis to increase precision of results. Results of the analysis of groups and missions were desired as indication of the need for control on these variables in future experiments. Table 3 shows that the mean difference between groups was statistically significant only for the Rights score. From Table 5, Group A had 24% more rights than Group B. Future experimentation should therefore use counterbalancing techniques in addition to matching techniques for control of examinee differences.

Mean differences between missions were significant at the .05 level for rights and for wrongs, but not significantly different for accuracy (Table 3). From Table 6, MSN 6358 had 28% more rights and 35% more wrongs than MSN 5536. Reports on MSN 6358 had a mean completeness of only 6% compared to 23% for MSN 5536. However, these figures must be interpreted with caution because, although equal time was allowed for interpretation of the missions, the test imagery from MSN 6538 consisted of 19 frames with 637 targets whereas only 13 frames with 115 targets were presented from MSN 5536.

CONCLUSIONS

Although implications of the findings from the present study can have only limited generalizability for Vietnam because of a multitude of uncontrolled variables--experience, scale of imagery, type of report, time allowed, etc.--results of a specific study such as this, based on reliable data, are important as guidelines in establishing a baseline for training and utilization of interpreters. Average completeness was only 7% for the no-key experimental condition, which may be representative of image interpreter performance for a novice going to Vietnam directly from the Image Interpretation Course and not yet immersed in the specific military situation nor having gained field experience. Even with use of the error key, completeness of interpretation was only 10%. The need for improved operational performance indicated by these results is reflected in the establishment of the present on-the-job training programs in Vietnam. Unfortunately, this training reduces the productive time in Vietnam during the one-year tour of duty.

A second major consideration is the level of accuracy of the reports. Mean accuracy of about 35% was found before use of the key. Even the 51% accuracy achieved with the key means that half the information provided is wrong, leaving considerable room for improvement and again indicating need for additional training, perhaps on the job. Training should include opportunity for feedback to the interpreter so that he can determine whether or not he was right or wrong in his report and learn by his mistakes. In this context, it is apparent that there is continued need for implementation of new team approaches and other interpreter techniques to bring about improvement.

SUMMARY OF RESULTS

The bESRL Error Key significantly improved the accuracy of inexperienced interpreters in dealing with operational imagery on Vietnam.

The Error Key significantly improved the completeness of reporting on imagery of Vietnam.

Differences in performance as a function of mission and group were evident.

There is considerable room for improvement in interpreter performance even with the error key.

OPERATIONAL IMPLICATIONS

The present key should be made operational.

For optimal operational use, the present key should be enlarged to include different areas of Vietnam, different scales and types of photography, and different sensors such as infrared.

Other geographical areas of potential interest should be considered as topics for an error key.

Consideration should be given to incorporating more training in error avoidance into the curriculum at the Intelligence School.

Error analysis should be applied to performance in the image interpretation course and on-the-job training to help define areas which need improvement.

APPENDIXES

APPENDIX A

INSTRUCTIONS TO THE EXAMINEE

A. Today we have a research project using imagery representative of operational imagery used in Vietnam.

This research, which we call an error study, is different from most research in that we are most interested in what you do wrong. We are hoping that by analysis of the special mistakes and the general types of errors made by you and the other classes who have worked with this imagery, we can develop methods for improving II keys.

As you may know, there is a DIA key (Insurgency and Counter-insurgency in Vietnam) dealing with Vietnamese imagery, and the 1st MI Bn (ARS) made a key for use in Vietnam. We are hoping that, from data determined by the research we conduct here, we will be able to develop guidelines for producing better keys, including supplemental keys in the field. We have several studies on scales, the type of perspective, use of drawings, and other aspects of how to put an II key together. Today's research is concerned not with how to format the key, but rather what to put in it. By asking you to interpret Vietnamese imagery with relatively little experience with the country and insurgency targets, we know you will make mistakes. The most common mistakes are, naturally, the topics which are most important for inclusion in a key. Thus, we call this an Error Study. By studying the errors which you make, we hope to be able to develop more efficient and effective keys oriented specifically to avoiding the common pitfalls in identification of COIN type targets.

B. TARGET LIST

The target list for use in this study is divided into two sections; a list of specific items to annotate, such as sampans, weapons positions, etc., and three types of information to report when appropriate, without requiring annotations. These three items, foxholes, road cuts, and trail activity, are discussed on the bottom of your target list. After you have looked at some of this imagery, it will be obvious that for many areas the counting and reporting of individual foxholes is a very tedious task, thus, we do not require you to annotate them but just to report the approximate number on the frame. Road cuts and trails are also found in quantity and need not be annotated individually.

Urban areas may be ignored completely, as obviously there will be too many personnel, vehicles, bridges, etc. to worry about in these areas. Urban areas where they occur will be designated on your prints.

Note that "weapons positions" includes covered and fortified positions, as well as open pits and firing bays along trenches, etc.

The targets which you do find are to be annotated with wax pencils on the paper prints and reported on the forms provided. The annotations should be made by neatly outlining the target or target complex and then numbering the annotation. Where items occur close together, it may be desirable to tie the number to the proper annotation with a "tick mark." Do not use large circles for annotations as they may include more targets than you report.

C. REPORTING FORM

The reporting form we will use for this test is fairly self-explanatory.

Mission number is the mission number from your envelope of imagery and the copy number--for instance, MSN 5536 Copy 19.

Frame number is indicated in the titling strip on each frame. Please use a separate form for each frame on which you report targets so that you can go back for additional items.

II name is your name.

Annotation number (col 1). You may annotate as you choose, but it will probably be easier to start over with number 1 on each frame.

Identification (col 2). It is important that you use the terms on the target list.

Quantity (col 3). Indicate quantities of weapons positions, personnel, etc. in this column.

Confidence (col 4). Indicate certain, probable, or possible, or some reasonable abbreviation thereof, for each target reported.

Remarks (col 5). The last column can be used for remarks about the target, the annotations, and any other comments you may wish to make.

The bottom three lines are already labeled with foxholes, road cuts and trails. Fill in confidence and quantities, etc., as indicated in the target list.

D. INTERPRETATION LOGGING FORM

In addition to our main research, we are also interested in the amount of time required to work with this type of imagery. We have prepared a logging form to record the time as you go along. The most efficient way is to tape the form down at the edge of your table. Please enter the clock time when you start, and each time you pick up a new print or go back to an old one. Enter the time and the frame number in the spaces provided. Record also the time when you start breaks and when you start to interpret again. From these data we hope to determine an average time per frame for various types of imagery and various target densities, for II's of your experience level.

We do ask that you work thoroughly and carefully. In all other classes, working with this Vietnamese imagery, the interpreters rushed through their interpretations and reported less than 10% of the actual targets present. You will have three hours of working time, plus a half-hour break. From time to time, we will tell you how many frames you should have completed so you can adjust your work pace as necessary.

E. MISSION 5536

This mission covers an area located approximately 40 miles northwest of Saigon. You will have 13 9 x 18 prints of the left split of a split-vertical mission flown at approximately 1:5,000 scale. You will have three hours to work with this imagery. You may take breaks as you desire, but do record the time on your logging sheet.

F. MISSION 6358

You will have 19 9 x 18 prints from this split-vertical mission. The area is located 15 to 20 miles southwest of Saigon and is mostly agricultural. Scale is approximately 1:5,000. You will have three hours to report targets from this mission, which is sufficient time to allow a thorough study of all frames. Take breaks as you see fit, but be sure to log the time.

APPENDIX B

VIETNAM ERROR KEY - 1

Top Figure

Annotation (1) shows a special type of walled graves which are frequently misidentified as vehicles. The length-width ratio, square corners, and flat appearance inside the low walls can be very deceptive when a few graves of this type are found in isolation. Noting the lack of clearly associated trackage and careful measurement will indicate these objects to be graves.

At (2) are some wells of a type ofte. mistaken for weapons positions. The lack of trackage, lack of association with other military activities, and absence of any military reason for being where they are, are often the best features for distinguishing these wells from military emplacements.

Personnel are often difficult to detect at this scale (1:5000). Their movement between exposure of a stereo pair, coupled with their small size, is often the best means of detecting them. Sometimes shadow or logical location are also helpful clues. At (3) are personnel along a road and in the courtyard of a building.

The red annotation (4) indicates some slow-down obstacles on a road. These serve the same function as road cuts but are built up on the top of the road. Note that these items at (4) are not vehicles, even though they have the same general shape and size. Indicators of their true nature are their staggered pattern on opposite sides of the road and the manner in which the traffic marks tend to go around them.

Bottom Figure

This illustration shows cultural activities in more open country. The items at (1) are not weapons positions but a type of mound grave which is sometimes found in groups, the older ones almost completely overgrown. General diagnostic features of graves--random arrangement, absence of trackage, size, siting, etc.--should be noted in making identifications.

Annotation (2) indicates not foxholes, but a type of well dug into the dikes between fields. Wells are usually old and regularly spaced along the entire length of the dike. Foxholes and weapons positions are usually more numerous and freshly dug.

At (3) are wells out in the fields, which illustrate the tendency to be central to the fields even more clearly than those in the top figure. Non-strategic location, lack of trackage, etc. are further evidence that these are neither weapons positions nor foxholes.

Personnel such as those at (4), are always difficult to detect at this scale.

Carts, as at (5), should be easily detected on roads and somewhat so in fields, particularly when hitched to oxen and moving. Small size, lack of regular shape when loaded, and lack of tonal contrast with many backgrounds, apparently cause many interpreters to overlook these items. In general, extra care must be taken to avoid missing such small items as personnel and carts.

At (6) in red are some mudpuddles which are not vehicles. Note the lack of sharp outline or square corners and in particular the way the pathways skirt these spots, indicating that they have been present for some time.

Top Figure

The rectangular grave mounds at (1) can be distinguished from weapons pits by the fact that the shadow indicates their mounded nature. The lack of trackage or weapons positions precludes their being fortifications despite appearance of substantial concrete construction. The number and siting are other clues to consider. Note also how some grave mounds at the very top of the frame are completely overgrown with brush which may look like camouflage.

Often an experienced interpreter may mistake a round earth scar for a weapons position. The irregular size, pattern, and lack of trackage or any distinct shadow help identify the features at (2) as craters, not weapons positions.

At (3), the mine field pattern results from stacking grain in shocks. Note the lack of strategic value to the location and the slight irregularity in the size and arrangement of the spots. Considering that this is 1:5,000 scale imagery, the spots are very large for mines.

Many things are found in the water other than sampans. Logs, brush, and garbage float down the streams, rocks protrude in spots, and tree shadows are frequently present along the margins. At (4) are indicated tree shadows and a log. Actual sampans are usually clearly identifiable when present.

At (5) are found a sampan in the water and one along side the river bank. Why sampans are frequently omitted on II reports is not clearly understood.

Personnel such as those at (6) are best identified by their small size, movement between exposures, and association with cultural activities such as houses or crops.

Carts may also be detected by movement or association with transportation routes or, as in (7), agricultural activities.

At (8), the clustered dark objects are not personnel but bunches of rice seedlings that have been collected together in bunches in the seedbed ready for transfer to the paddy below. Note that these rice bunches are too blocky in appearance to be personnel, cast no noticeable shadow because they are so short, lack the white spot of a coolie hat, show no motion in stereo, and are too neatly organized to be a bunch of personnel.

At (9), the objects are not vehicles because the "road" shows only trail traffic. There is a severe road cut at the upper 1/3 of the annotation and the outline of the objects is fuzzy compared to the sharp outline of the graves at (1). The objects at (9) are bushes commonly found on the broader, higher dikes.

Bottom Figure

The items at (1) are not weapons positions but rather grave mounds similar to those in the upper stereo pair, and the same indicators apply. This is another example of the serious error of calling a grave a weapons position.

The shrines at (2) are larger and more elaborately constructed than most graves but lack the trackage, field of fire, or strategic location of a weapons position.

Tree shadows and logs such as at (3) are often mistaken for sampans but lack the size and clarity of outline of a true sampan. Usually, the tree casting the shadow can be found.

At (4) are personnel distinguished by their size and location on trails or in the fields.

The sampans at (5) are clearly sampans, in contrast to those pseudo-sampans at (3), but have nevertheless been omitted in the reports of some interpreters. Note that sampans do occur on land where they are pulled up for maintenance or storage.

The objects at (6) are neither vehicles nor personnel. By comparison with the houses nearby, they are too small to be other than little carts, but too big and blocky to be personnel. Noting the similar regularly spaced pattern at the top side of the same paddy confirms their identification as strawstacks.

The items at (7) are too tall to be vehicles and too blocky and lacking in movement to be personnel. They are rather neatly aligned to be bushes and rather tall and spindly to be strawstacks. Perhaps they had best be called Unidentified objects (UIO's).

Top Left Figure

This photo, at 1:8000 scale, illustrates graves and craters, two types of circular objects which inexperienced interpreters often call foxholes and weapons positions. At (1), the quantity and highly random arrangement of the 'revetted' walled entrances protruding from the circle is a prominent feature with this type of grave.

At (2), the random size and arrangement, spoil, and lack of symmetry identify these objects as craters. When weapons positions or foxholes do occur in and around cratered areas, great care must be taken to distinguish between the two types of holes in the ground.

Vietnamese trails (3) often look very much like roads and do fulfill many of the functions of roads, even though much narrower. However, their carrying capacity is limited and if considered a road and used as an indicator of scale, gross errors may result. Compare these trails with the tank tracks in upper center.

Shrines such as at (4) are found infrequently. They are distinguished from fortifications by the lack of defenses other than the walls themselves, and the absence of military clutter.

Annotation (5) indicates personnel on a trail. Note that if the trail was erroneously considered a road, the personnel might be misidentified as vehicles.

Top Right Figure

Graves such as those at (1) may occur in large or small groups. In large groups they are readily distinguished from military positions by their random pattern, even if individual graves do look like AA, AW, or artillery positions. In smaller groups, proper identification may take more care, and even masses of graves should be checked for military positions which may be hidden amongst them.

Size is the most important factor in identifying annotation (2) as a trail. Compare its width with the width of a dike in a rice paddy; such dikes are rarely more than 24" wide.

Size is also the most significant feature in identifying the brush and/or grass hummocks at (3). After the trail had been identified as a road by several inexperienced interpreters, these objects were called a convoy of vehicles along the road, when actually they are less than two feet wide.

Bottom Left Figure

In this illustration are numerous craters which have been misinterpreted as other military activity. At (1), air-burst bombs have left large circular scars with scalloped edges and no noticeable pit. Particularly in more heavily vegetated areas, such craters have been mistaken for assembly points or supply points when the radial marks of the thrown-out spoil were thought to be trails.

At (2) we have shell craters which are distinctive because of their appearance like an edge view of a flying saucer. This is because the main bursting force goes to either side with a secondary force forward and very little force extending back toward the weapon. These shell holes are misidentified as foxholes or weapons positions when the lateral extensions are thought to be access trails.

Comparison with the tank tracks at (4) or the shell holes and bomb craters indicates that the trace at (3) is far too narrow to be a road and thus must be a trail.

Bottom Right Figure

Many civilian features are misidentified as military.

The round-walled graves at (1) look very much like AA positions but lack the proper arrangement, spacing, communications trenches, ammo revetments, and fire control center which would be associated with a true AA position.

Rectangular or square walled shrine/graves such as those at (2) may look like fortifications but have their own characteristic appearance, different from the characteristic military installation with its firing bays, trenches, supplies, strategic location, etc.

At (3) is a temple complex which has the appearance of parade grounds, barracks, and other components of a military installation. However, the manicured gardens, sculptured ponds, complete absence of defenses or military clutter, and the large number of graves surrounding the complex indicate its non-military nature.

The clumps of bushes at (4) are not vehicles. Look closely to note the individual bushes and do not be misled by the length-width ratio and square corners into thinking that they are vehicles. Note that these objects leave no trackage.

The drainage ditch or ravine at (6) is not a trench. It is too broad, irregular in outline, and mottled in texture. Compare with (5) which is a trench.

APPENDIX C:

SEA TARGET LIST

WEAPONS POSITIONS	- Designate type if possible, including AA, AW, artillery, mortar, etc. and indicate whether or not occupied.
BUNKERS	- Buildings of heavy construction or otherwise fortified, not to include rooms excavated into hillsides or fortified weapons positions.
TUNNEL ENTRANCES	- Includes rooms dug into hillsides.
TRENCHES	- Include only military trenches (firing or communication), not canals or irrigation ditches.
FOOT/BICYCLE BRIDGES	- Do not report vehicle bridges.
ROAD BLOCKS	- Built-up barricades only; do not include road cuts.
STRONG POINTS	- Indicate number of weapons positions and whether or not occupied.
TRIANGULAR FORT	- Indicate condition--occupied, unoccupied, abandoned, etc.
PERSONNEL	- Indicate quantity and what they are doing.
SAMPANS	- Designate motorized or non-motorized, if possible.
VEHICLES	- Indicate type--ox-carts, trucks, pedicabs, etc.
SUPPLY POINT	- Includes both storage and distribution/transshipment types. Indicate occupied/unoccupied.

Fill in the following information on the bottom portion of your answer sheet. It is not necessary to make annotations for these items.

FOXHOLES	- Estimate the number on the entire frame, including overlaps with previous frames.
ROAD CUTS	- Count the number of sections of road containing road cuts of any type. Do not count individual pits or ditches.
TRAILS	- Estimate the number of trails and indicate their apparent usage--to and from fields, between villages, no apparent reason for existence.
CONFIDENCE	- C = Certain Prob = Probable Poss = Possible

APPENDIX D

INTERPRETATION REPORT FORM

MISSION NO. _____

FRAME NO. _____ II NAME _____

1	2	3	4	5	6	7
ANNOT. NO.	IDENTIFICATION	QTY	CONF	REMARKS		
	Roadcuts					
	Trails					
	Foxholes					

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

APPENDIX E

ANALYSIS OF VARIANCE FOR THREE DEPENDENT VARIABLES IN EXPERIMENT

Source of Variation	Sum of Squares	DF	MSS	F
	RIGHTS			
Between Groups	610.63	1	610.63	8.104*
Person Within Group	9041.80	120	75.35	
	9652.43	121		
Within:				
Keys	1475.41	1	1475.41	41.549*
Missions	844.73	1	844.73	23.789*
Error	4261.36	120	35.51	
	6581.50	122		
Total	16,233.92	243		
	WRONGS			
Between Groups	579.41	1	579.41	1.614
Person Within Group	43,069.05	120		
	43,648.46	121		
Within:				
Keys	2124.59	1	2124.59	17.906*
Missions	2124.59	1	2124.59	17.906*
Error	14,237.82	120	118.65	
	18,487.00	122		
Total	62,135.46	243		
	ACCURACY			
Between Groups	443.61	1	443.61	0.741
Person Within Group	71,855.18	120	598.79	
	72,298.79	121		
Within:				
Keys	12,393.92	1	12,393.92	69.656*
Missions	626.56	1	626.56	3.521
Error	21,351.51	120	177.93	
	34,372.00	122		
Total	106,670.79	243		

*$F_{.05}(1,120) = 3.92$.